GENERAL

Lbs = mg/l x MGD x 8.34 (lbs/gal)

Circumference of a circle = π x diameter, or 2 x π x radius where $\pi = 3.14$

Area of a circle = $\pi (r^2)$, **or** 0.785 x (d^2) d=diameter r=radius

Area of a triangle = $\frac{1}{2}$ base x height

Area of a rectangle = length x width

Volume of a cylinder = area of the circular base x height

Volume (ft^3) = length (ft) x width (ft) x depth (ft)

Volume of a cone = 1/3 x (volume of a cylinder)

Volume of a tank = cubic feet (ft^3) in the tank x 7.48 gals/ft^3

Temperature Conversions: $\text{Centigrade} = \frac{\text{Fahrenheit - 32}}{1.8}$, $\text{Fahrenheit} = \frac{9}{5}\ \text{Centigrade + 32}$

Geometric mean = $\text{antilog of } \frac{\text{sum of logs of sample results}}{\text{number of samples}}$

Volume/Concentration conversion mls x normality = mls x normality

Slope = Rise/Run

Percent Slope = Rise/Run x 100%

Watts = $\text{volts x amps} = \frac{\text{voltage}}{\text{ohms}}$

PROCESS CONTROL

Detention time (hrs.) = $\frac{\text{tank volume in gallons x 24 hr./day}}{\text{flow in gallons per day}}$

% Efficiency of Removal = $\frac{\text{mg/l influent - mg/l effluent}}{\text{mg/l influent}} \text{ x } 100\%$

Pond population equivalent, in persons = $\frac{\text{Flow in MGD x BOD in mg/l x 8.34 lbs/gal}}{\text{0.2 lbs BOD/day/person}}$

Pond area, acres = $\frac{\text{average width in ft. x average length in ft}}{43560\ \text{ft}^2/\text{acre}}$

Pond volume, acre feet (ac ft) = area in acres (ac) x depth in feet (ft)

Pond influent flow in ac-ft/day = $\frac{\text{gals per day}}{7.48\ \text{gal/ft}^3 \text{ x } 43560\ \text{ft}^2/\text{acre}}$

Pond detention time (days) = $\frac{\text{pond volume in ac-ft}}{\text{influent rate in ac-ft/day}}$

Pond hydraulic loading, inches per day = $\frac{\text{depth of pond in inches}}{\text{detention time in days}}$

Pond organic loading (lbs. BOD/day/acre) = $\frac{\text{BOD in mg/l x MGD x 8.34}}{\text{pond area in acres}}$

Pond population loading = $\frac{\text{population served in \# of persons}}{\text{pond area in acres}}$

% Settleable Solids = $\frac{\text{mls of settled sludge after 30 min.}}{\text{vol. of settleometer}}$ x 100

Sludge Volume Index (SVI) = $\frac{\text{(\% settleable solids x 10,000)}}{\text{MLSS in mg/l}}$

Recirculation ratio for trickling filters = $\frac{\text{recirculated flow}}{\text{influent wastewater flow}}$

Surface loading (overflow) rate, gpd/ft^2 = $\frac{\text{flow in gpd}}{\text{surface area in ft}^2}$

Weir overflow rate = $\frac{\text{flow in gpd}}{\text{feet of weir}}$

Trickling Filter Organic Loading, lbs/day/1000 ft^3 = $\frac{\text{BOD applied in lbs. per day}}{\text{volume of media in 1000 ft}^3}$

Trickling Filter Hydraulic Loading, gpd/ft^2 = $\frac{\text{gal/day (including recirculation flow)}}{\text{surface area in ft}^2}$

Mean cell residence time (MCRT) in days

$$= \frac{\text{MLSS in mg/l x MG (aer. tank + sec. clar. vol.) x 8.34}}{\text{(Eff. SS in mg/l x MGD x 8.34) + (WAS in mg/l x WAS MGD x 8.34)}}$$

Sludge age, days = $\frac{\text{MLSS in mg/l x aerator volume in MG x 8.34}}{\text{Primary Eff. SS in mg/l x MGD x 8.34}}$

BOD_5 (unseeded), mg/l = $\frac{DO_i - DO_5}{p}$

where DO_i = Initial DO

DO_5 = DO after 5 days

$$p = \frac{\text{mls of sample}}{\text{300 (mls in a BOD bottle)}}$$

BOD5, mg/l (seeded) = Seeded BOD mg/L = $\frac{(DO_I - DO_5) - ((SB_I - SB_5) * f)}{P}$

Where f = $\frac{\text{mls of Seed in Sample}}{\text{mls of Seed in Seed Blank}}$

p = $\frac{\text{mls of Sample}}{\text{300 mls}}$

Wasting rate, gpm = pumping rate, MGD x 694 gpm/MGD

Total Suspended Solids (TSS), mg/l = $\frac{\text{dry solids in grams x 1000 mg/g x 1000 ml/l}}{\text{sample volume in mls}}$

or = $\frac{\text{weight of solids in mg x 1000 mls/l}}{\text{sample volume in mls}}$

Total Solids (TS), mg/l = $\frac{\text{A - B x 1000}}{\text{sample volume in mL}}$

where A = weight of dish + dried residue in milligrams
B = weight of dish in milligrams

Volatile Solids (VS), mg/L = $\frac{\text{(A - B) x 1000}}{\text{sample volume in mL}}$

where A = weight of residue + dish before ignition in milligrams
B = weight of residue + dish after ignition in milligrams

Percent (%) Volatile Solids = $\frac{\text{(A - C) x 100}}{\text{A-B}}$

where A = weight of dish + dried residue in milligrams
B = weight of dish in milligrams
C = weight of residue + dish after ignition in milligrams

F/M (food to microorganism) ratio = $\frac{\text{BOD (or COD) in mg/l x MGD x 8.34}}{\text{MLVSS in mg/l x aeration basin vol. in MG x 8.34}}$

Dry solids to a digester, lbs/day = sludge in gpd x 8.34 x $\frac{\text{\% Total solids}}{100}$

Volatile Solids to a digester, lbs/day = sludge in gpd x 8.34 x $\frac{\text{\% Total Solids}}{100}$ x $\frac{\text{\% Vol. Solids}}{100}$

Volatile Solids Destroyed in a digester, lbs/day/ft^3

$$= \frac{\text{Volume of sludge in gal/day x \% solids x \% volatile x \% reduction x 8.34}}{\text{Digester volume in ft}^3}$$

% Volatile Solids Destroyed in a digester

$$\%\ \text{reduction} = \frac{(\text{in}) - (\text{out})}{(\text{in}) - (\text{in} * \text{out})} * 100$$

Return Activated Sludge (RAS) Rate calculated using Settleability

MGD = Secondary influent flow, MGD x Return Sludge Rate Ratio

where **Return Sludge Rate Ratio** $= \frac{\text{30 min settled sludge volume in ml/l}}{\text{clear liquid volume in ml/l}}$

Total waste activated sludge (WAS) in MGD = current rate in MGD + additional rate in MGD

Stream Conc. Formula $= \frac{\text{lbs/day discharged from plant + lbs/day upstream total flow}}{\text{MGD (plant flow + stream flow) x 8.34}}$

Nitrogenous Oxygen Demand (NOD), mg/l = NH_3, mg/l x 4.6 mg/l O_2 per mg/l NH_3 converted to NO_3

Ultimate Oxygen Demand (UOD), mg/l = (1.5 x BOD, mg/l) + (4.6 x NH_3, mg/l)

Chemical Oxygen Demand, mg/l

$$= \frac{\text{(mls of FAS to titrate blank - mls of FAS to titrate sample) x normality of FAS x 8000}}{\text{mls of sample}}$$

*(*FAS = Ferrous Ammonium Sulfate)*

Waste Activated Sludge (WAS) pumping rate $= \frac{\text{Solids to be wasted in lbs/day}}{\text{WAS SS in mg/l x 8.34}}$

PUMP/FLOW

Q = A x V where Q = quantity of flow (in units of ft^3/sec.)
A = cross sectional area
V = velocity

Velocity in ft/sec $= \frac{\text{flow rate - in } ft^3\text{/sec}}{\text{cross-sectional area - in } ft^2}$

Water horsepower (Water HP) $= \frac{\text{gpm x total head in ft}}{3960}$

Brake horsepower (Brake HP) $= \frac{\text{flow in gpm x total head in ft}}{\text{3960 x pump efficiency}}$

Motor horsepower (Motor HP) $= \frac{\text{gpm x total head in ft}}{\text{3960 x pump efficiency x motor efficiency}}$

Pump electrical costs/year
= hp x 0.746 kW/hp x # of hrs pump operates per day x cost ($) per kW/hr x 365 day/yr.